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# Mangrove Ecosystems of Gulf of Mannar, Tamil Nadu

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## Introduction

Mangroves are termed as 'Tropical tidal wet lands' with typical vegetations distributed along the border of the sea and lagoons reaching upto the edges of the rivers to the point where the water is saline and growing in swampy soils covered by the saline water durng high tides. The mangroves dominate almost one quarter of world's tropical coastline. When conditions are favourable, they may form extensive and productive forests protecting the coastline. Mangrove ecosystem serves as the reservoir of species of plants and animals associated together. The mangrove swamps and forests are more diverse and luxuriant in the Indo-Pacific region. The mangroves of India have received inadequate and insufficient attention in the past. Most of the mangroves are on the verge of disappearance due to over-exploitation. No sustainable effort has been made to study them in a comprehensive manner.

There has been increasing awareness among the scientific community that the mangrove biotope is an important component of the tropical ecosystem. The role of mangroves in nature and their ecological significance have been realised of late and the Government, scientific Institutions and Universities are paying increasing attention to the biology, conservation and management of mangrove areas. Apart from the economic uses of its resources, the mangroves are potential grounds for coastal aquaculture. It is generally recognised that mangrove areas form the breeding and nursery grounds for the larvae and juveniles of many commercially important species of prawns and fishes. The high productivity resulting from mangrove litterfall supports a host of detritus feeding animals such as amphipods, mysids, harpacticoids, molluscs, crabs and larvae of prawns and fishes. The mangrove vegetation and associated creeks and channels provide habitats to these organisms especially in their critical stages of life-history. The role of the mangrove forests in stabilizing the shoreline or coastal bed is well known, The important role played by the mangrove forest and swamps in the production of detritus, dissolved organic matter and recycling of nutrients is being increasingly realised.

## Districation of Indian mangroves

The world's total mangrove area which spans over 30 countries including those for the various island nations is about 1,00,000 sq. km. The total area of the Indian mangroves is estimated at 6,81,976 hectares of which nearly 45% occurs in Sunderbans and the islands in the Bay of Bengal. Other important mangroves are Killai and Pichavaram and Gulf of Mannar Islands in Tamil Nadu, state of Kerala, Karnataka, Gulf of Kutch and Andaman &

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Nicobar islands. The Andaman-Nicobar islands contain some of the least disturbed and best preserved mangroves. The Andaman-Nicobar islands have about 1,190 sq. km. area of mangroves. Here, the forests are gregarious type, dominated by single species. The Sunderbans formed in the vast delta complex of the Ganga and Brahmaputra river systems are usually described as the largest single natural mangrove block having an area of 4,170 sq. km. in W. Bengal. It is noteworthy that today, in Kerala, there is no dense mangrove forest in spite of its generally very heavy rainfall as compared to the other States of the west coast of India. It is contrary to the general rule that the maximum development of mangroves is in the regions with heavy rainfall. Tidal currents and freshwater supply influence the physico-chemical factors in the mangrove estuarine systems to govern the distribution and zonation of the mangrove species, of which temperature and salinity of the ecosystem appear to be important factors.

On the basis of the height of the vegetation, 3 categories of forest stratification can be observed in a normal mangrove ecosystem. The widest trunk with spreading crown is found in species of ***Sonneratia*** and ***Avicennia*** and less spreading crown found in the species of ***Bruguiera*** and ***Rhizophora*** which constitute the top canopy of the forest. The second category is contributed by shrubs and small trees represented by the species of ***Aegeceros, Exoecaria*** and ***Ceriops***. The third one is occupied by small shrubs and ferns such as species of ***Acanthus, Aegiolitis*** and ***Acrostichum.*** Globally, mangrove ecosystems are though to contain about sixty species of true mangrove trees and shrubs and more than twenty additional species frequently associated with the mangrove flora. They exhibit a remarkable capacity for salt tolerance and hence they are physiological halophytes. The leaves possess halophilous properties with thick cuticle, large mucilage cells etc. The formation of butress and stilt roots and vertical pneumatophores are characteristic adaptations. The composition of the mangrove species changes with depth, salinity, wave action, intertidal exposure etc. Diversity in the structural formation and zonation of mangrove forests can be witnessed along the latitudinal gradients and probably also along the longitudinal gradients that reflect climatic, especially rainfall gradients. Across the latitudinal gradients, air temperature and across the longitudinal gradients, water and soil fertility appear to be the most important factors in determining the growth patterns of the mangrove populations.

## Influence of mangroves on flora and fauna assemblage

Mangrove systems are among the most productive natural ecosystems on earth. The sources of primary productivity are the mangrove vegetation themselves, algal colonies associated with the mangrove root surfaces and the moist forest floor and the phytoplankton communities in the associated bay and lagoons. Algae observed in the intertidal regions of mangroves are very rich and diverse in both quality and quantity. The benthic algae of the mud surface are represented by the green filamentous species of ***Enteromorpha, Rhizoclonium, Monostroma*** and ***Ulva.*** The mangrove environment provides living space for a dependent biota of more than two thousand species of flora and fauna of resident, semiresident or migratory mode of life. The mangrove associated fauna, being a composite of terrestrial, estuarine and marina organisms, constituting representatives of almost all invertebrate phyla and fishes have to face numerous interactions between animals of terrestrial and aquatic biotopes. As such, the mangrove fauna with its lower species diversity but with relatively large number of individuals is highly characteristic in nature. The primary food source for aquatic organisms in most mangrove dominated estuaries occurs in the

form of particulate organic matter (detritus) derived chiefly from the decomposition of mangrove litterfall. The annual litterfall normally ranges from 10,000 to 14,000 kg dry weight per hectare. An additional sources of nutrition is provided by dissolved organic compounds of mangrove origion. The predators feed on the detritus feeders and form important food source for both aquatic as well as terrestrial wild life in addition to forming food resource for human beings.

In general, the fauna of mangroves constitute insects, crustaceans, molluscs, fishes, snakes, crocodiles, birds, monkeys and some other mammals. Very few studies are made with respect to plant animal interactions. The mangrove waters are rich in detritus providing a highly potential area for fishing. The major fishery sources in these waters are detritus species of fishes, crustaceans and molluscs. It has been estimated that the yield of mangrove-cum-estuarine dependent fisheries of India to the tune of 30,000 tonnes of crustaceans per annum. Roughly about 60% of India's coastal marine fish species are dependent on the mangrove estuarine complex. Some of the most common fishes of mangroves are species of ***Liza, Mugil, Polynemus, Ilisha*** and ***Etroplus.*** Prawns are represented by the species of ***Penaeus*** and ***Metapenaeus*** while crab resource waters are species of ***Crassostrea, Meretrix, Telescopium*** and ***Cerethedia***. The major gears used for fishing are stake-nets, cast-nets and hand-picking in the mangrove areas.

There are 5 important factors that influence mangroves, namely, temperature, salinity, tides, rainfall and winds; each having its own effect. Temperature influence the development and survival of the mangroves in the early stages. Salinity determines the distribution and zonation of the species within the ecosystem since each species has got its salinity tolerance. Tides act jointly with salinity in the dispersion and zonation; and the tidal amplitude determines the landward extension of the mangroves. Rainfall is important in the zonation of mangroves on flat coasts and the productivity of the mangrove ecosystem is related to the frequency and volume of freshwater supply by rainfall. Wind is important in regulating the seasonality of litterfall which is the major pathway of energy from terrestrial, to aquatic system. Mangroves colonize on a variety of substrata that include silty and clayey mud, calcareous mud, quartz sand, calcareous sand or mixture of these. Occasionally they may colonize coastal coral reef as well as cracks and hollows of rocky substrata. They prefer sediments that have been brought by rainwater or transported by tidal currents. The mangrove soils are generally slightly acidic. The anaerobic condition in the soil helps sulphate reducing bacteria to produce Hydrogen sulphide. The characteristic black or grey colour of the soil is due to reduction of ferric compounds to ferrous sulphides.

In general, atmospheric mean temperature of most of the mangrove habitats in the Bay of Bengal varies from 29-33°C while surface soil temperature ranges from 30-34°C and surface water temperature from 28-33°C. Salinity of mangroves fluctuates considerably ranging from 3 to 33 ppt in landward and creek waters; and in the bay it varies from 25 to 35 ppt. The pH of the water fluctuates from 6.5 to 8.0 and dissolved oxygen content is usually very low ranging from 1.7 to 3.8 mg/l. However in the seaside, it may reach even 10 mg/l. The primary productivity of the mangrove waters is very high. Gopinathan and Rajagopalan have been reviewed the productivity of the Andaman-Nicobar mangroves. According to Nair and Gopinathan (1983), the primary productivity rate ranges from 0.2 to 0.8 g C/m$^3$ / day in the northern Andamans, slightly higher values from 0.5 to 1.0 g C/m$^3$ day in the shallow mud flats and mangroves of Car Nicobar and higher productivity rates from 2.0 to 3.6 g C/m$^3$/day in and around the mangroves of Port Blair. In recent years, the mangrove environment is getting polluted with

different kinds of effluents and other contaminants from the factories and industrial wastes. Heavy metals pose a serious problem due to their environmental persistence and toxicity to aquatic organisms even at a lower concentration. Hence, it is very important to monitor the Heavy metal pollution by taking suitable managerial measuresto protect the valuable mangrove resources. Increasing human pressure for domestic needs and development of industries are virutally destroyed large areas of virgin mangroves all over the world. Reclamation of mangroves for housing, agriculture and salt evaporation site, grazing of cattle, removal for fuel, sewage discharge with high BOD, discharge of industrial effluents and excessive release of pesticides and aquaculture practices have threatened most of the mangroves and some are in the verge of extinction. These degraded areas need to be restocked and fresh mud-flats need to be afforested with suitabie mangroves. Silvicultural techniques like regeneration, restoration and afforestation of mangrovescan be the only answer to these problems.

Like any other types of forests, mangroves from the national wealth of a nation. Timber produced from mangroves is of great value. Wood of ***Rhizophora*** is used for boat-building which is resistant to termites and boring animals. Mangrove trees are used as fuel wood or for charcoal. Mangroves were the main source of tannin industry once but now gradually replaced by synthetic tannin. A black dye is also extracted from the bark of mangrove trees. Seeds of ***Cerebra odlun*** is poisonous and fish poisons are extracted from it. Mangroves are good breeding and nursery grounds for a variety of prawns and fishes. It provides nutrition for various organisms through recycling of plant and animal remains. Of course, mangroves give protection to the coastline and minimise the disaster due to cyclones. Aquaculture practices in the mangrove sites of many countries are flourishing even now. Protection of bird sacntuaries and endangered species of wild life (crocodiles and tigers) are the other important aspects of mangroves. Mangrove ecosystems, with their variety of subhabitats, offer range of recreational opportunities such as boating, hunting, bird watching, wild life observation, education trips for specimen collections, photography etc. A part from these, fishery activities (culture and capture) in many coastal regions of the tropics are highly dependent upon mangrove dominated estuaries. Aquaculture in mangroves signifies a case of necessity rather than suitability. In specific cases of aquaculture in the mangrove ecosystem economic and social benefits may outweight management problems. A major part of the primary production enters the mangrove food-web a dead organic ecosystem or transported into the adjoining water body in a degraded form and the estuaries and backwaters fringed by mangroves have long been used for rearing or fattening of bivalves, prawns and finfishes.

## Mangrove ecosystems of Gulf of Manner, Tamil Nadu

A survey on the distribution of various species of mangroves in Shingle, Krushadi, Poomarichan, Manoli-putti, Manoli, Hare, Muli, Poovarasanpatti, Anaipar, Upputhannai, Kasuwar, Valai, Appa, Nallathanni, Karaichalli, Vantivu, Talayari, Valimunai, Puluvinichalli, Vilanguchalli and Rameshwaram islands of Gulf of Mannar was conducted during January, 1995 - December, 1997. The various species of mangroves such as ***Avicennia marina, Rhizophora mucronata, Brugeiera cylindrica, Ceriops decandrus, Luminitzera racemosa, Exoecaria agallocha*** and ***Suaeda*** spp., are distributed in these selected islands surveyed. It may be revealed that Krushdai, Manoli and Poomarichan islands are found to be more productive in mangrove vegetation when compared to other islands of Gulf of Mannar. Survey on fish and prawn seed resources was undertaken in the mangrove

areas of selected islands of Gulf Mannar such as Krusadai, Hare and Poomarichan islands and Rameshwaram (Pamban) to find out the influence of mangroves on fish and prawn seed abundance. Simultaneously, survey on fish and prawn seed resources in the non-mangrove areas i.e., marine habitat of the above islands was carried out for comparative studies.

## Conservation and management

In India, mangroves are under pressure due to increasing population, development of ports, salt pan and aquaculture, dumping of industrial wastes and effluents, development of fertilizer plants and exploitation for petrochemical activities. Conversion of mangrove area for aquaculture and residential purposes is also leading to loss of this important ecosystem. Based on the above observations, a concerted and co-ordinated effort is necessary to undertake management measures to conserve these natural resources. With a view to preventing further destruction of mangrove forest, it is felt that an integrated approach is required. The conservation of the existing mangrove resources is the first step towards achieving this goal.